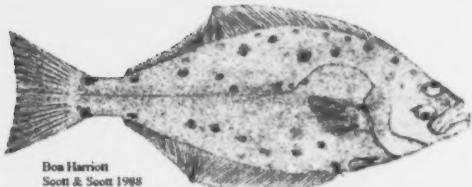
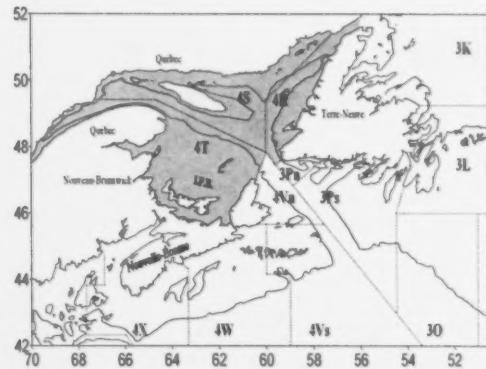




## STOCK ASSESSMENT OF ATLANTIC HALIBUT OF THE GULF OF ST. LAWRENCE (NAFO DIVISIONS 4RST) FOR 2009 AND 2010



Don Harriett  
Scott & Scott 1988



Map of the Gulf of St. Lawrence and neighbouring regions showing NAFO divisions 4RST.

### Context

The Atlantic halibut commercial fishery in the Gulf of St. Lawrence began at the end of the 19<sup>th</sup> century. During the first half of the 20th century, this resource was exploited by American and Canadian fleets. It was quite common to see annual landings totalling thousands of tons. Beginning in the second half of the 20<sup>th</sup> century, exploitation was almost exclusively carried out by the Canadian fleet from the four Atlantic Provinces as well as Quebec. From over 600 t during the 1960s, landings have steadily decreased until the early 80s, totalling 90 t in 1982. Landings increased again in the late 90s and now total 650 t, which is near the level observed 45 years ago.

The current Atlantic halibut stock management unit in the Gulf, NAFO Divisions 4RST, was defined in 1987. In 1988, Management introduced the first TAC set at 300 t. This TAC was increased to 350 t in 1999 following recommendations by the FRCC, and was increased to 475 t in 2007 and to 600 t in 2010. A minimum legal catch size set at 81 cm was added to the halibut exploitation conditions in 1997. The minimum legal catch size was increased to 85 cm in 2010. The fishing season begins on May 15 and ends on May 14 the following year. The directed Atlantic halibut fishery is practiced on a competitive basis and is carried out by longliners. Atlantic halibut represent a by-catch for other fleets, in particular the gillnet Greenland halibut fleet. Landings of Atlantic halibut by this fleet totalled over 10% of the overall landings in the Gulf in 2010.

Assessment of the resource was conducted on an annual basis until 2005 and biennially since. The current assessment puts into perspective the available information on the biological characteristics of halibut in the Gulf and its commercial exploitation for 2009 and 2010 compared to 2008. It also mentions some concerns raised by Science, Management and the fishing industry, concerning halibut by-catches in the directed fishery for other groundfish species.

## SUMMARY

- Preliminary landings as of December 31, 2010 were 626 t, or 4% more than the total allowable catch (TAC) for the 2010-2011 fishing season that was set at 600 t. These landings represent the second highest value since the 1960s. The 2010-2011 TAC was increased by 26% while the minimum legal catch size was increased from 81 to 85 cm. Reported landings in 2009-2010 reached 672 t, exceeding the 475 t TAC by 40%. They are the highest in 45 years.
- In 2009 and 2010, approximately 80 t were landed as by-catches in the gillnet fishery. Over 80% of these catches were from the Greenland halibut fishery. Data from at-sea observers indicate that these catches are composed largely of individuals smaller than the minimum legal size that are neither landed nor counted. Thus, the mortality of fish discarded at sea by turbot fishermen is presumed very high (over 50%).
- During the 2000s, the abundance and biomass indices from the scientific trawl surveys showed a sharp increase in the Gulf, both for pre-recruits (<minimum legal size) and for recruits ( $\geq$  minimum legal size). Maximum values were observed between 2007 and 2010. The range of sizes measured is substantial. The median size is higher and variable in the north (60 to 75 cm) than in the south (50 cm) of the Gulf.
- Catches per unit effort calculated for the directed Atlantic halibut fishery using longlines have consistently increased since the early 2000s, reaching their maximums in 2009 and 2010.
- In 2010, longline catches recorded at sea showed that pre-recruits are still abundant (% in numbers) whereas the proportion of halibut larger than 130 cm was about 10%.
- The mean modal size, measured at sea and dockside, was around 85 cm for the 1997-2009 period. The majority of females landed were immature since the length at which 50% of females are mature is 130 cm.
- Over the past 10 years, all indices have increased significantly. Under these conditions, considering a TAC increase of around 20%, total over the next two years, abundance indices should still continue to increase.
- Given the significance of Atlantic halibut discards at sea in some fisheries, in particular immature individuals, management measures should be implemented to account for and reduce these discards in order to protect the spawning stock's growth potential. In this regard, a more accurate method for assessing the magnitude of these discards should be developed.

## INTRODUCTION

### **Species Biology**

Atlantic halibut is the largest flatfish and prized species on the market. However, knowledge pertaining to its biology and stock status in the Gulf of St. Lawrence is limited.

Atlantic halibut (*Hippoglossus hippoglossus*) of the Gulf stock (NAFO Divisions 4RST) can be found throughout the Estuary and Gulf of St. Lawrence. The average annual growth rate of Atlantic halibut in the Gulf was evaluated at 7.5-8.5 cm. Male and female growth rates are comparable. However, females reach a larger maximum size than males. This could be due to the fact that Atlantic halibut females reach sexual maturity at a larger size than males, as observed for the Scotian shelf stock and the southern Grand Banks stock (NAFO Divisions 3NOPs4VWX). Size at sexual maturity ( $L_{50}$  where 50% of fish are mature) is 130 cm for females from the Gulf stock (DFO, 2009). Based on observations made during scientific trawl surveys indicate that Gulf halibut is able to spawn between January and May.

The diet of the Atlantic halibut Gulf stock, as determined from stomach contents collected between May and November, is similar to that described for Atlantic halibut elsewhere. In the Gulf, halibut of less than 30 cm eat mainly invertebrates (krill, northern shrimp and other shrimp), while larger halibut have a more piscivorous diet (Denis Chabot, Maurice Lamontagne Institute, pers. com.). Thus, halibut measuring 30-80 cm mostly feed on snow crab, shortfin squid and different species of small fish (e.g. capelin, fourbeard rockling, witch flounder, blennies, eelpouts and sculpins). Commercial size halibut primarily feed on herring, cod, rockfish and flatfish.

Results from the Atlantic halibut tagging program conducted in the Gulf and in sub-division 3Pn indicate that tagged fish in the commercial fishery are mainly recaptured in the same division they were tagged or in the Gulf stock management unit (NAFO Divisions 4RST). A small percentage (about 15%) of individuals was recaptured outside the Gulf management unit. The latter was defined in 1987 based on the tagging-recapture study results and on additional biological information (e.g. size, growth rate).

### **Description of the Fishery**

The significant landings (average of around 1,500 t) of Atlantic halibut harvested in the Gulf of St. Lawrence during the first half of the 20<sup>th</sup> century indicate that this stock was once very abundant and that it was subjected to an intense fishing pressure (Figure 1). Halibut landings, which were around 650 t in the early 1960s, hit a record low in 1982 at 91 t. Until 1995, they seldom exceeded 300 t, which is equivalent to the TAC (Total Allowable Catches) established in 1988. Ranging between 230 and 420 t between 1996-2004, landings exceeded 500 t in 2008 and reached levels similar to the 1960s in 2009 and 2010 (600+ t) (Table 1).

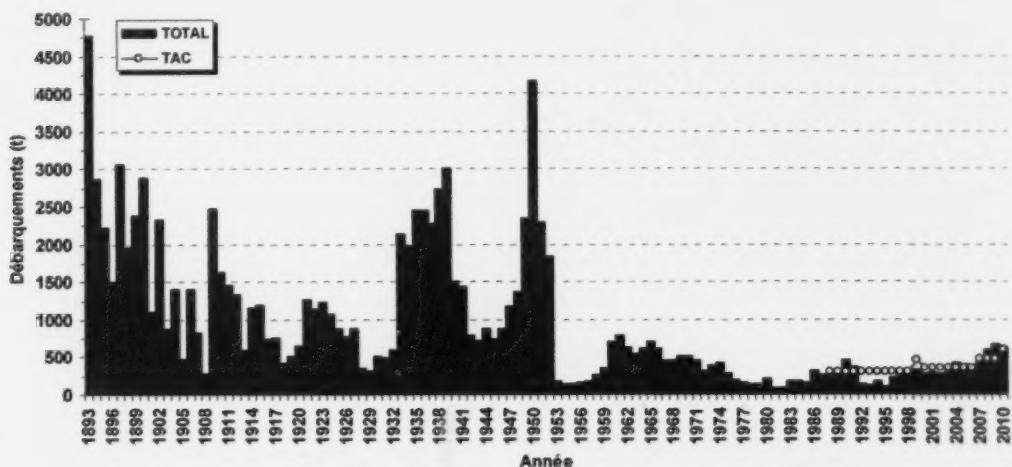


Figure 1. Atlantic halibut annual landings (t) and Total Allowable Catches (TAC) for NAFO Divisions 4RST. The 2010 data are preliminary.

Table 1. Atlantic halibut landings (t) in Divisions 4RST.

Division	Year									
	1953-1969 <sup>1</sup>	1970-1987 <sup>1</sup>	1988-1995 <sup>1</sup>	1996-2004 <sup>1</sup>	2005	2006	2007	2008	2009	2010 <sup>2</sup>
TAC	nil	nil	300	300-350	350	350	475	475	475	600
4R	197	95	79	102	155	144	142	228	253	203
4S	144	74	65	111	82	101	163	167	190	175
4T	91	77	92	96	177	144	127	165	202	248
Total	435	245	236	309	413	388	432	560	645	626

<sup>1</sup> Average

<sup>2</sup> Preliminary data as of December 31, 2010

Following a recommendation from the Fisheries Resource Conservation Council (FRCC), the TAC for the 1999 fishing season (January 1 to December 31) was increased to 350 t. Due to the application of the new groundfish management period extending the 1999 fishing year from May 15 of the current year to May 14, of the following year, an additional TAC of 100 t was granted by Management to cover this period only. The TAC was increased and set at 475 t for the 2007, 2008 and 2009 fishing seasons, and was increased to 600 t for 2010. This latest increase was introduced to meet the needs of industry. In 2010, the TAC was divided, for Quebec and the four Maritime provinces, into eight geographical fixed-gear fleets. Directed fishing for Atlantic halibut is practiced on a competitive basis and is carried out by longliners.

Several management measures have been introduced over the years to protect the resource, in addition to the TAC. In 1997, a minimum legal catch size of 81 cm, based on a yield and value per recruit model, was added to the Canadian commercial fishing license conditions for Atlantic halibut. In 2007, Science had recommended that any catch increase be accompanied by a gradual increase in the minimum legal catch size. This last management measure was not introduced until the 2010 fishing season, along with the 600 t TAC increase, even though fishery stakeholders opposed it on the grounds that certain markets prefer halibut of 80-100 cm (under

25 lbs). Thus, in 2010, the legal minimum size was set at 85 cm for the Gulf stock, and halibut below that size would have to be returned to the water.

The mandatory discarding of commercial size halibut by-catches by certain cod directed longline fleets was introduced as of 2008. Thus, all halibut of 81+ cm had to be returned to the water in the Gulf, Maritimes and Newfoundland and Labrador regions (as well the Magdalen Islands when the TAC was reached). The other fleets in the Quebec region had to keep their catches on board and land them. In 2010, the discarding of commercial size halibut by-catches ( $\geq 85$  cm) caught by longline in the directed cod fishery was only mandatory in Newfoundland. It should be noted that halibut discarding is not recorded or accounted for.

There are other existing management measures such as: dockside commercial catch monitoring program, at-sea coverage by observers (percentage varies based on the fleets), mandatory logbook, predetermined fishing periods, limits on the number of hooks per line, minimum opening of the hook, by-catch protocols and, for certain fleets, a vessel monitoring system (VMS). Finally, a quota conciliation program was introduced in 2010 and will become effective at the start of the 2011 fishing season. Consequently, any fleet exceeding its quota in a given year will see its quota reduced the following year by the equal amount exceeded.

As of December 31, 2010, reported preliminary landings totalled 626 t, or 4% more than the 600 t TAC granted for the fishing season ending on May 14<sup>th</sup>, 2011 (Table 1). Consistent with the last 10 years, over 95% of the landings were made by the fixed gear fleet, primarily longliners (Table 2). Since 2006, there has been a significant increase in halibut by-catches made by gillnets, representing 10-20% of the total halibut landings. Among the Atlantic halibut landings by gillnets, 50+% of these were from the Greenland halibut directed fishery (Table 3). More than 90% of the catches are made within a four-month period (May-August). It should be noted that since the mid-2000s, the increase in landings is consistent with a decrease in fishing effort or the annual number of fishing days. Although the 2009 and 2010 landings are comparable to those made in the 1960s (600+ t), landings are still below the thousand-ton level often recorded during the first half of the 20<sup>th</sup> century (Figure 1).

**Table 2. Atlantic halibut commercial landings (t) by gear for Divisions 4RST. The 2010 data are preliminary.**

YEAR	FIXED GEARS					MOBILE GEARS					Unknown			TOTAL	TAC			
	Gillnet	Handline	Longline	Trap	Others	TOTAL	%	Bottom trawl (fish)	Bottom trawl (shrimp)	Pelagic trawl	Danish seine	Others	TOTAL	%	TOTAL	%		
1988	33	17	137	0	0	187	78.6	23	23	5	0	0	51	21.4	0	0.0	238	300
1989	73	18	135	0	0	226	77.7	50	15	0	0	0	68	22.3	0	0.0	291	300
1990	69	34	238	0	0	341	75.6	94	13	0	0	0	107	23.7	3	0.7	451	300
1991	43	7	263	0	0	313	88.5	32	13	0	0	0	45	12.4	4	1.1	362	300
1992	11	3	88	0	0	100	70.4	11	23	0	7	0	41	28.9	1	0.7	142	300
1993	19	4	96	0	0	119	93.0	1	8	0	0	0	9	7.8	0	0.0	128	300
1994	20	0	91	1	0	112	83.3	4	2	0	2	0	8	4.5	57	32.2	177	300
1995	23	0	35	7	0	65	85.7	3	0	0	0	0	3	3.0	31	31.3	99	300
1996	14.2	26.0	154.0	4.2	0	198.4	84.5	10.3	0.8	0	0.4	2.4	13.9	5.9	22.4	9.5	234.7	300
1997	32.5	0.6	230.2	0.1	0	263.4	89.0	7.1	2.4	0	5.5	8.2	23.2	7.8	9.5	3.2	296.1	300
1998	20.6	0.1	272.9	0.5	0	294.1	91.8	10.0	0.6	0	0.3	1.6	12.5	3.9	13.6	4.2	320.2	300
1999	29.5	0.3	218.7	0	0	248.5	94.1	11.5	1.1	0	0.7	2.3	15.6	5.9	0	0.0	264.1	450
2000	27.3	0.8	271.0	0	0	299.1	95.3	13.2	0.6	0.2	0.2	0.5	14.7	4.7	0	0.0	313.8	350
2001	25.7	0.4	274.8	0	0	300.9	98.0	7.8	1.8	0	0.7	2.3	12.4	4.0	0	0.0	313.3	350
2002	16.7	0.9	287.4	0	0	305.0	95.0	7.6	1.9	0	0.8	1.7	12.0	3.8	1.5	0.5	318.5	350
2003	24.3	0	270.9	0	0	295.2	96.1	7.9	2.0	0	0.1	1.9	11.9	3.9	0	0.0	307.1	350
2004	20.7	0.6	384.6	0	0	405.9	97.6	3.5	2.8	0	2.7	1.1	10.1	2.4	0	0.0	416.0	350
2005	28.8	1.1	386.9	0	0	386.8	98.1	4.9	2.0	0.1	5.1	4.0	18.1	3.9	0	0.0	412.9	350
2006	42.6	1.5	330.6	0	0.9	375.6	98.8	6.5	1.5	0	2.3	2.1	12.4	3.2	0	0.0	388.0	350
2007	63.5	1.7	348.2	0	0	413.4	95.8	4.0	3.6	0	1.1	0.4	18.1	4.2	0	0.0	431.5	475
2008	106.8	0	440.5	0	0	547.3	97.8	1.9	4.4	0	1.8	4.3	12.4	2.2	0	0.0	559.7	475
2009	78.6	5.4	548.0	0	0	632.0	97.9	7.6	2.6	0	0.6	2.5	13.3	2.1	0	0.0	645.3	475
2010 <sup>1</sup>	82.6	17.1	516.3	0	0	616.0	98.4	4.9	3.1	0	0	1.9	9.9	1.6	0	0.0	625.9	600
1988-2009 <sup>2</sup>	37.4	5.6	249.1	0.6	0.1	292.7	88.0	14.6	5.7	0.2	1.4	2.0	24.0	8.2	6.5	3.8	323.1	300-475
2005-2009 <sup>3</sup>	64.1	1.9	406.8	0.0	0.2	473.0	96.9	5.0	2.8	0.0	2.2	4.5	14.5	3.1	0	0.0	487.5	350-475

<sup>1</sup>: data from preliminary ZIF

Table 3. Atlantic halibut landings (*t*) from different directed fisheries in 4RST. The 2010 data are preliminary.

	Directed Species								
	Halibut (t) %		Cod (t) %		Lumpfish (t) %		Turbot (t) %		All (t)
Year	Used gear: Longline								
2005	271.7	74.1	70.4	19.2	0	0.00	3.5	0.96	366.9
2006	291.0	88.0	34.1	10.3	0.04	0.01	2.0	0.61	330.6
2007	309.9	89.0	33.0	9.5	0	0.00	3.8	1.09	348.2
2008	361.8	82.1	77.9	17.7	0	0.00	0.3	0.08	440.5
2009	506.0	92.3	43.9	8.0	0	0.00	1.6	0.29	548.0
2010	498.7	96.6	17.5	3.4	0.06	0.01	0.9	0.01	516.3
Year	Used gear: Gillnet								
2005	2.2	7.6	1.2	4.3	1.10	3.81	10.9	37.7	28.8
2006	0.7	1.6	0.1	0.2	6.46	15.16	24.5	57.5	42.6
2007	0.6	0.9	1.1	1.8	6.45	10.16	36.9	58.1	63.5
2008	0.5	0.4	1.0	0.9	11.35	10.63	88.2	82.5	106.8
2009	0.1	0.1	0.5	0.6	7.05	8.97	64.3	81.8	78.6
2010	0.6	0.8	0.7	0.9	5.99	7.25	70.7	85.6	82.6

## RESOURCE ASSESSMENT

### Distribution, Abundance and Biomass

The available data on the abundance and biomass of Atlantic halibut in the Gulf were provided by the two summer scientific trawl surveys conducted by the DFO in the Northern and Southern Gulf, the two mobile-gear summer Sentinel fishery program surveys conducted in the Northern and Southern Gulf, and the cod directed longline Sentinel fishery program activities in the Southern Gulf.

Halibut catches made during the trawl surveys are distributed throughout the Estuary and Gulf of St. Lawrence (Figure 2). In the Estuary and northern part of the Gulf, halibut are more abundant at depths of 200+ m in the Esquiman, Anticosti and Laurentian channels. In the southern part of the Gulf, catches are generally made at shallower depths (less than 100 m) around the Magdalen basin and along the southern edge of the Laurentian Channel. For all the surveys, the distribution index values (area of occupancy: DWAO, Smedbol *et al.*, 2002; geographical extent: D95, Swain and Sinclair, 1994), based on halibut catches, have risen sharply over the 2000s and are now at very high levels compared to the early 1990s (Figure 3).

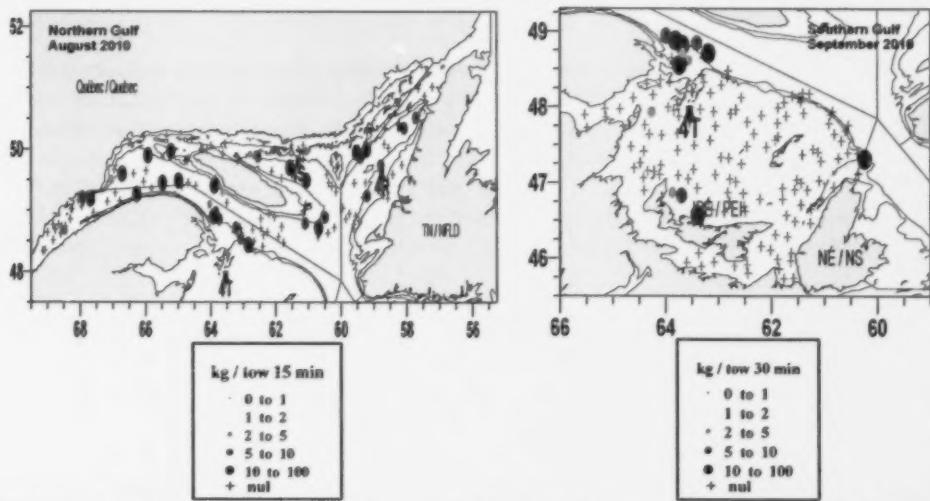


Figure 2. Spatial distribution of catch rates for Atlantic halibut observed in the DFO scientific trawl surveys in the summer of 2010.

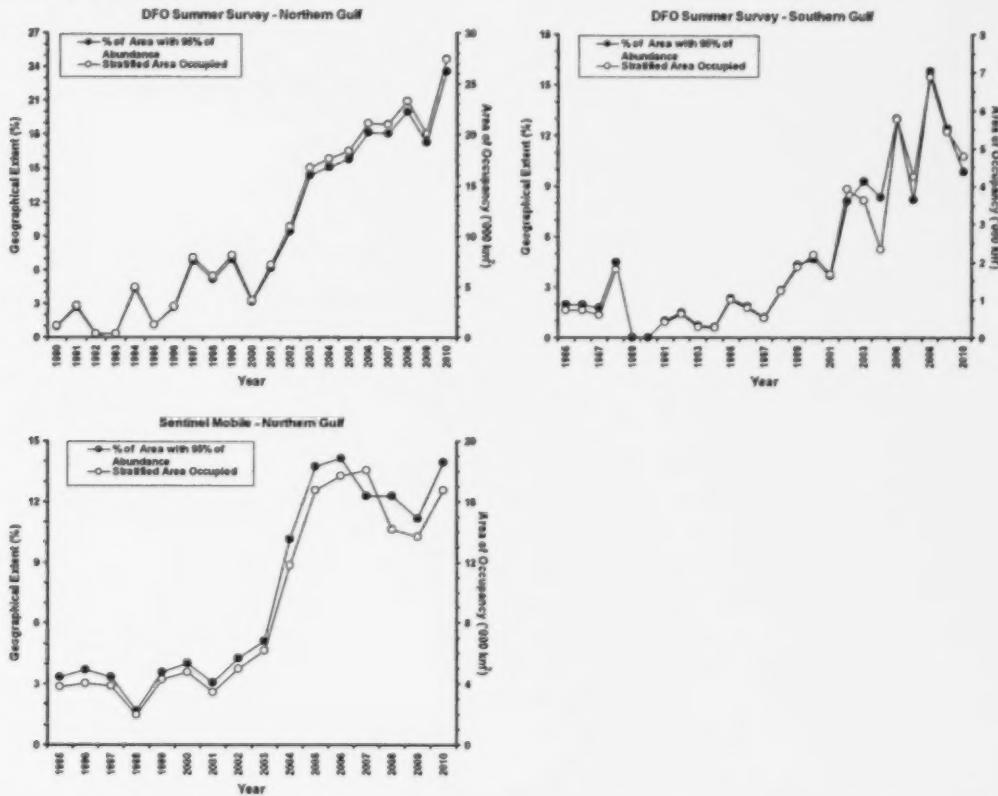
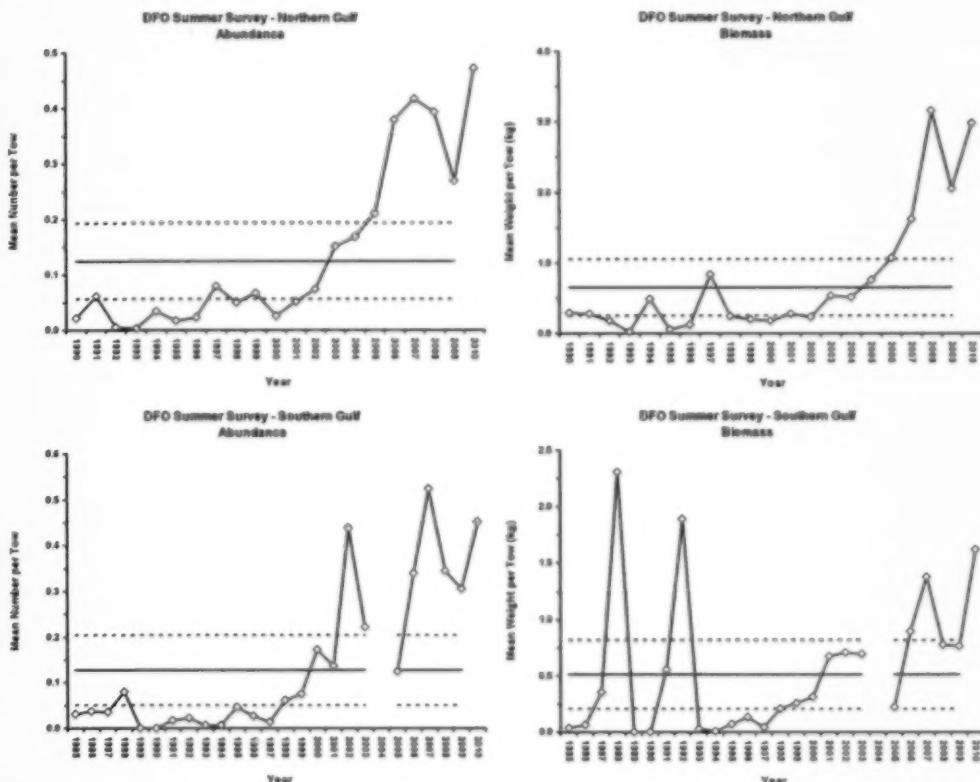


Figure 3. Distribution indices (DWAO and D95) of Atlantic halibut calculated for the scientific trawl surveys.

Even if the trawl catchability for large-size Atlantic halibut is reduced on account of their avoidance capability, the trends observed in terms of abundance and biomass reflect changes in stock abundance, particularly with regard to pre-recruits. Thus, since the early 2000s, indices have more than quadrupled for the DFO surveys in the Northern and Southern Gulf, and the values observed over the last five years have been among the highest of the series (Figure 4). The Sentinel fishery summer trawl survey in the Northern Gulf shows the same trend, and the highest values have also been recorded since 2006 (Figure 5). However, the abundance index values observed for the Sentinel fishery surveys in the Southern Gulf remained relatively stable between 2003 and 2008, and then rose as of 2009 (Roderick Morin, DFO-Gulf Region, pers. com.).



**Figure 4.** Atlantic halibut abundance and biomass indices estimated from the DFO summer scientific trawl surveys (the solid line represents the series average including all years except 2010, and the dashed lines  $\pm 0.5$  standard deviation).

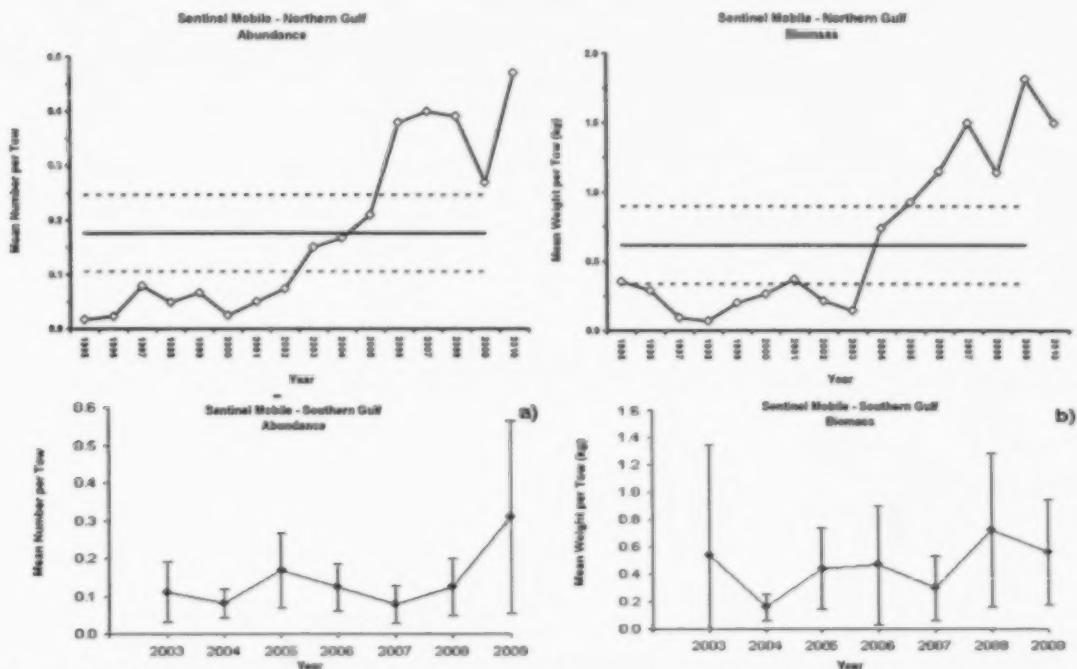


Figure 5. Atlantic halibut abundance and biomass indices estimated from the Sentinel fishery summer trawl surveys (the solid line represents the series average including all years except 2010, and the dashed lines  $\pm 0.5$  standard deviation) (data source for the Southern Gulf: Roderick Morin, DFO-Gulf Region, pers. com.).

### Fishing Effort and Catch Rate

Fishing effort and catches per unit effort (CPUE) were calculated using (1) statistics from the commercial longline fishery (catches and effort) directed on Atlantic halibut and (2) scientific logbooks completed by Newfoundland fishermen. The CPUE is defined as the weight (kg) of halibut caught per 1,000 hooks. CPUE data were standardized to account for differences between fleets, fishing areas, soak time and fishing months.

The catch rate spatial distribution pattern observed in 2009 and 2010 represents the halibut geographic distribution in the Estuary and Gulf of St. Lawrence (Figure 6). Based on the available data, the highest halibut catch rates are on the Miscou Bank, on the north side of Prince Edward Island and around the Magdalen Islands in the Southern Gulf, and near the Anticosti, Esquiman and Laurentian channels in the Northern Gulf. Since the early 2000s, CPUE have been increasing steadily, both for the 4RST management unit as a whole but also for each division (Figure 7). Values from the last four years are among the highest of the series. At the same time, fishing effort dropped sharply from 2000-2003, followed by fluctuations or it continued to decrease, except for Division 4T where, since 2008, high effort levels have resumed.

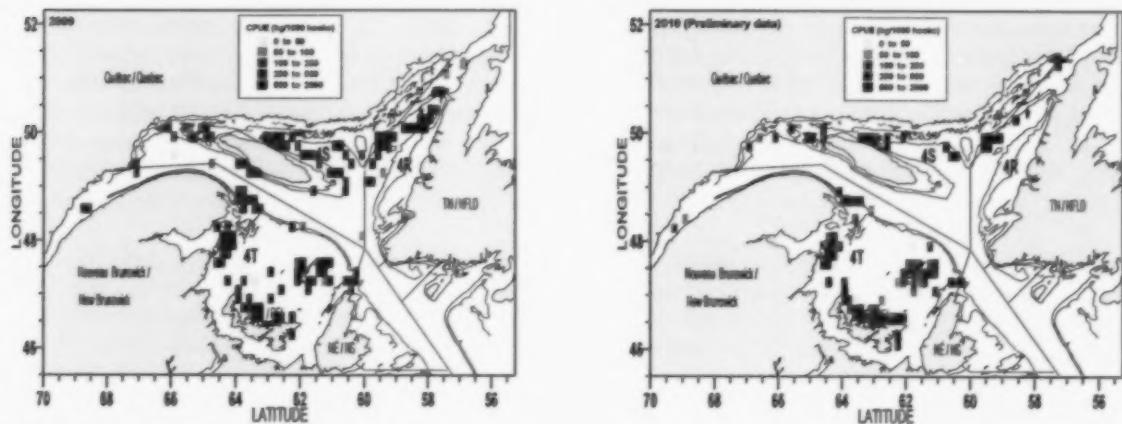


Figure 6. Catch rate spatial distribution for the Atlantic halibut directed longline fishery in 2009 and 2010.

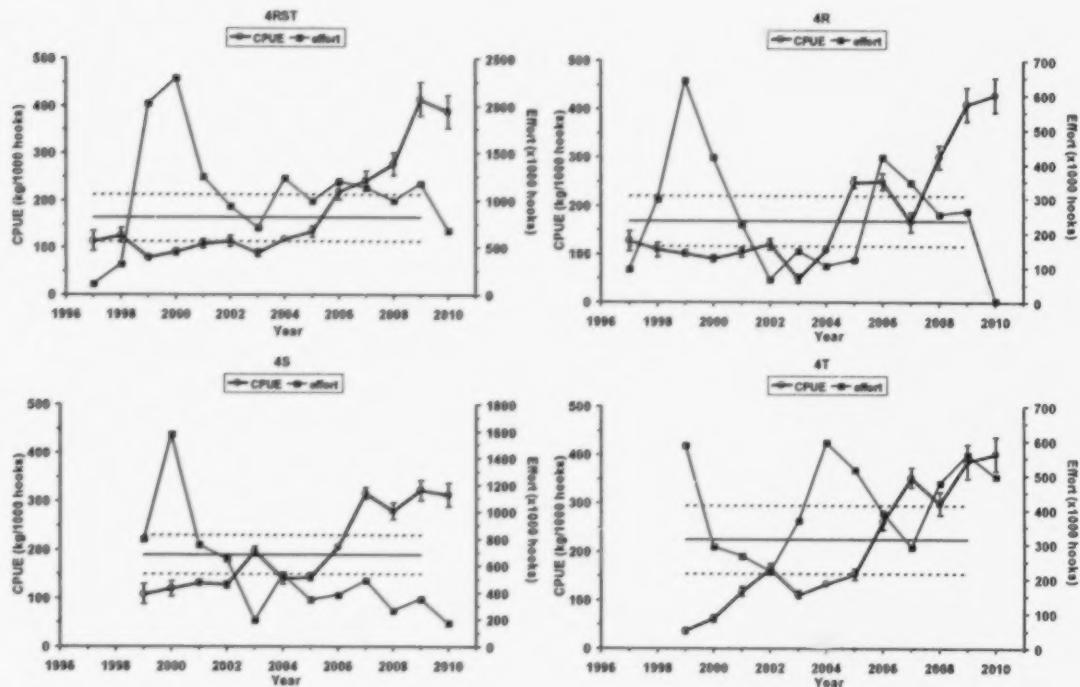


Figure 7. Atlantic halibut directed longline commercial fishery indicators, per management unit and NAFO division from 1997 to 2010. The 2010 data are preliminary (the solid line represents the CPUE series average including all years except 2010, and the dashed lines  $\pm 0.5$  standard deviation).

## Size and Recruitment

The size range of halibut measured during the **scientific trawl surveys** is mostly between 20 and 120 cm (Figure 8). Catches are mostly made up of halibut measuring less than 80 cm. During the 2000s, the mean size in the Northern Gulf was generally above 60 cm, as opposed to the Southern Gulf where it rarely exceeded 50 cm (Figure 9). Analysis of median size revealed the same trends, with the average median in the Northern Gulf at 55-85 cm according to the survey, and rarely exceeding 55 cm in the Southern Gulf. The weak representativeness of individuals measuring more than 120 cm in the catches can be explained in part by the reduced catchability of the trawl for larger size halibut which are able to avoid the gear.

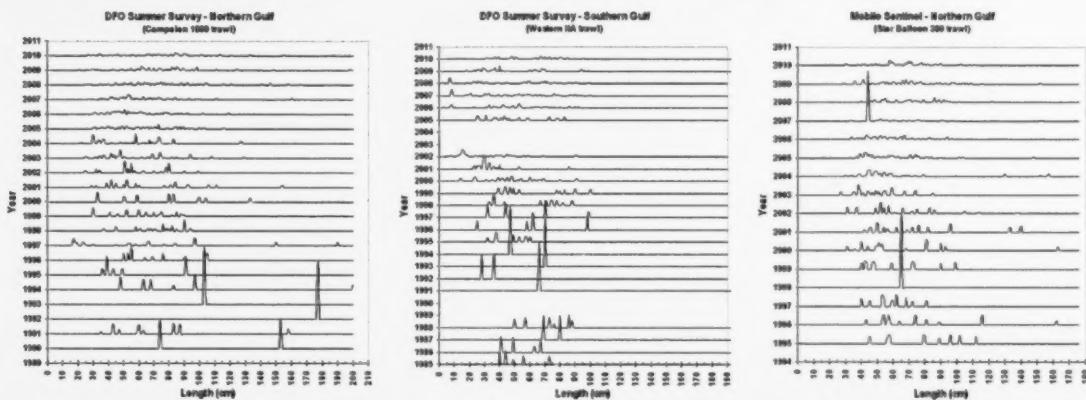


Figure 8. Size composition (%) of Atlantic halibut captured during the summer scientific trawl surveys, between 1985 and 2010.

During the 2000s, the size of landed fish by the longline **commercial fishery** was between 81 and 120 cm (80+% of the landings), with a mean size varying between 90 and 100 cm (Figure 10). In 2010, with the minimum legal catch size increasing to 85 cm, the mean size exceeded 100 cm. However, modal size (representing the size of halibut most frequently landed) remains comparable to what was observed the previous year, which suggests that the fishery targets the most represented mode in the size distribution. The samples measured at sea by the observers indicate that the proportion of fish under the legal size in the catches can, from year to year, be significant (more than a third of the total; Table 4). The mean size of pre-recruits was estimated at 67 cm for the 2000-2009 period, and it increased to 72 cm in 2010.

*Table 4. Importance of Atlantic halibut size categories in catches made at sea, according to fishing gear type.*

Gears (Year)	Proportion (%) of total catches at sea					
	Sublegal size		Commercial size		Large size (≥120cm)	
	Weight	Number	Weight	Number	Weight	Number
<b>Longlines</b>						
2007	11.6	34.1	88.4	65.9	32.2	8.1
2008	15.9	39.6	84.1	60.5	24.2	6.4
2009	7.2	18.4	92.8	81.6	17.6	4.7
2010	10.9	33.4	89.1	66.6	39.3	13.1
<b>Gillnets</b>						
2007	59.0	85.0	41.0	15.0	5.8	0.4
2008	44.7	86.8	55.3	13.2	14.5	1.4
2009	33.0	72.3	67.0	27.7	18.8	3.5
2010	38.6	75.0	61.4	25.0	1.1	0.1

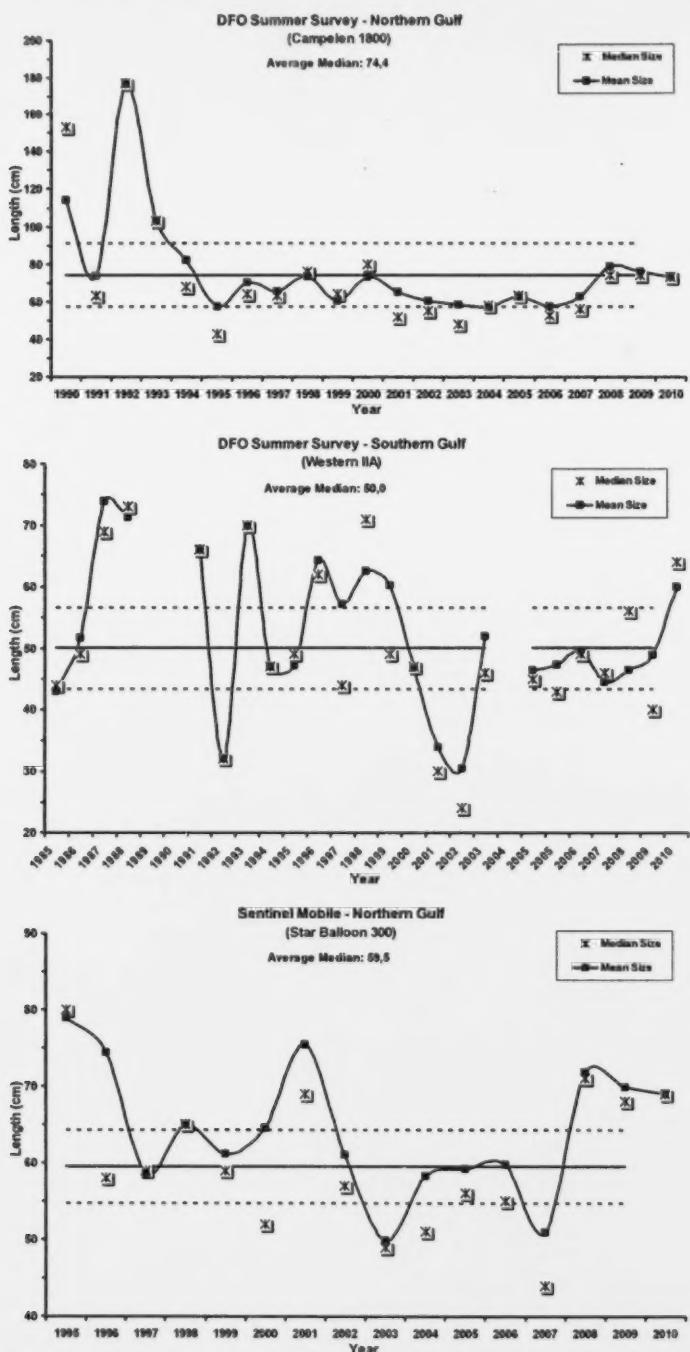
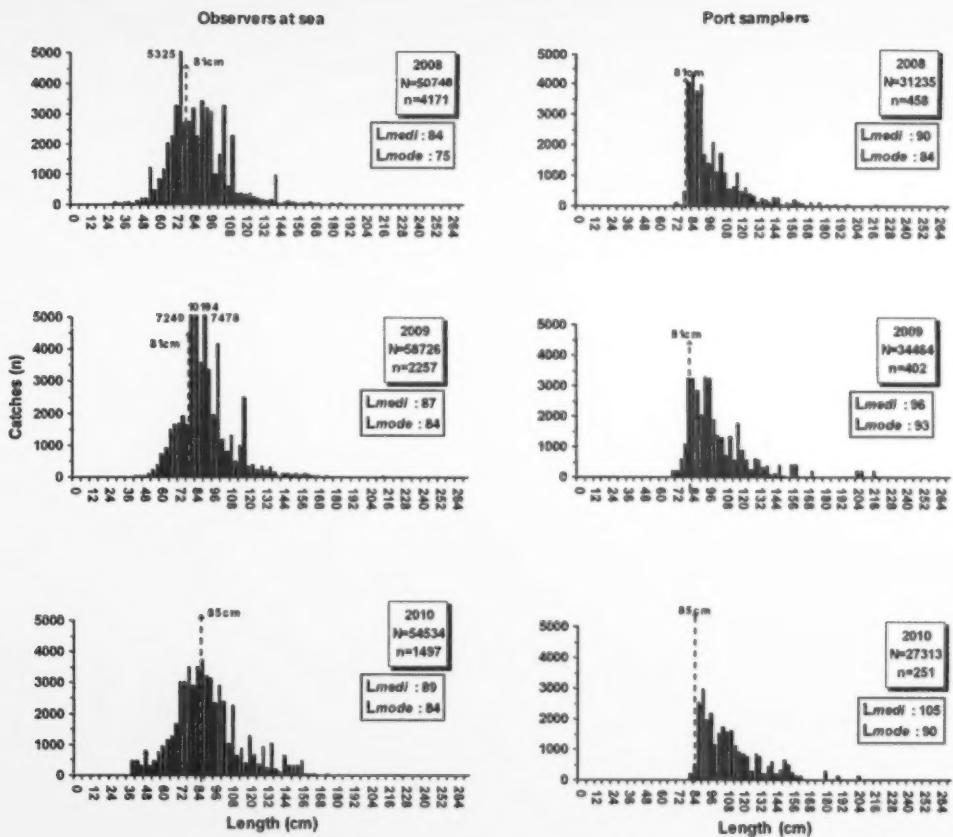


Figure 9. Median and mean sizes of Atlantic halibut captured in the summer scientific trawl surveys between 1985-2010. (the solid line represents the average median of the series including all years except 2010, and the dashed lines  $\pm 0.5$  standard deviation).



**Figure 10.** Size frequency distribution of Atlantic halibut measured at sea and dockside for the longline commercial fishery (N: estimated total number of Atlantic halibut found in catches; n: total number of Atlantic halibut measured in samples; L<sub>med</sub>: median length; L<sub>mode</sub>: modal length; minimum legal catch size is indicated with an arrow).

A more in depth analysis of the halibut catches made with longlines and gillnets was conducted using at-sea observers' data from 2007 to 2010 (Table 4; Figure 11). During these years, the proportion of commercial size halibut found in catches made by longliners was over 60% in numbers and 80% in weight. However, proportion of sub-legal size halibut in gillnet catches was over 70% in numbers and between 30-60% in weight. The median size for all gillnet catches did not exceed 65 cm.

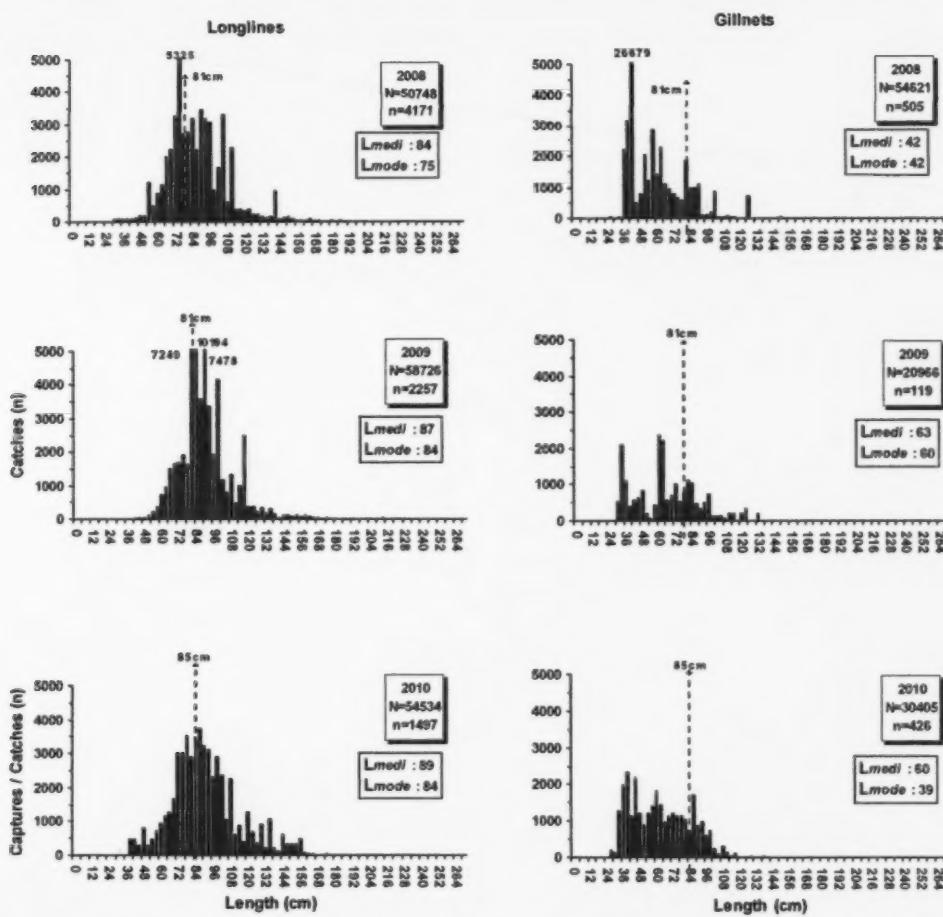


Figure 11. Size frequency distribution of Atlantic halibut measured at sea in commercial catches using longlines and gillnets, (N: estimated total number of Atlantic halibut found in catches; n: total number of Atlantic halibut measured in samples; L<sub>medi</sub>: median length (cm); L<sub>mode</sub>: modal length; minimum legal catch size is indicated with an arrow).

## Sources of Uncertainty

### Release back into the water of Atlantic halibut by the gillnet fleet

Fishing with gillnets, including the Greenland halibut directed fishery, can yield large quantities of Atlantic halibut which a significant portion must be returned to the water as these fish are under legal catch size. According to data provided by at-sea observers, volumes of released fish could be significant (49 t in 2010). However, industry disputes these estimates alleging a non-random assignment of observers who often target problem cases. Nevertheless, the survival of Atlantic halibut caught by gillnets is very uncertain. A study in the Gulf during the Greenland halibut fishery (Sylvain Menegat, University of Quebec at Rimouski, and Alain Fréchet, Maurice Lamontagne Institute, pers. com.) indicated that over a third of Atlantic halibut caught were already dead when

nets were raised. There has been no assessment concerning the survival of fish released back into the water. Consequently, there is significant uncertainty regarding the actual fishing related mortality rate which is certainly higher than the rate associated with the landing statistics by the gillnet fleet.

#### Release back into the water of Atlantic halibut by the longline fleet

For longline catches, the survival of smaller fish returned to the water could be good (95+) in ideal handling conditions so as to minimize injuries (Neilson *et al.*, 1989; Trumble *et al.*, 2000). However, in a fishery where the discarding of Atlantic halibut by-catches is mandatory (e.g. Atlantic cod directed fishery), the survival rate can be greatly reduced for larger size individuals (100+ cm) because of their weight (15+ kg) and their combative strength which increases the difficulty of handling them without injuring them. For Pacific halibut, a closely related species to Atlantic halibut, the survival rate calculated for halibut caught as a by-catch in the longline fishery directed at other species, was highly variable (35 to 95%) and decreased with the severity of injuries.

#### Subdivision 3Pn and the management units

Atlantic halibut from subdivision 3Pn was not included in the two Atlantic halibut stocks created in 1987 on the Canadian east coast. In 2002, the FRCC recommended as a temporary measure to set the catch limit (preventive TAC) at 40 t, based on the historic annual catch levels, until the stock structure had been better defined. Until 2007, the reported halibut landings from 3Pn rarely exceeded 40 t. However, since 2008, they have been consistently higher than the preventive TAC.

## **ADDITIONAL STAKEHOLDER PERSPECTIVES**

Representatives from the Association des capitaines propriétaires de la Gaspésie (ACPG) questioned the representativeness of the high percentages of discards of Atlantic halibut under legal catch size, caught by gillnets in the Greenland halibut fishery, estimated by the observers. They mention the low percentage of coverage by the Observer program (10-30% of outings), but mostly that the latter are often directed at problem cases for regulatory compliance reasons. These estimates are arguably not representative of the entire turbot fleet. Nevertheless, the industry recognizes that the release of small fish by turbot fishermen is a problem and that mitigation solutions must be considered.

Nonetheless, industry points out that the stock appears to be in good health: 1) the majority of indicators are above or comparable to the series average considered, particularly with regards to catch rates; 2) there appears to be a reserve of large spawners that provide a good recruitment for upcoming years. For these reasons, there seems to be little concern for a TAC increase.

## **CONCLUSIONS AND ADVICE**

As was shown from the data collected during the scientific surveys (increasing distribution, abundance and biomass indicators) and from the commercial fishery (increasing CPUE and decreasing effort), the Atlantic halibut stock in the Gulf has increased over the last five years. However, given that the majority of fish landed are immature, the restoration of the spawning stock

remains a concern. In fact, the minimum legal catch size and the modal size are far below the size at sexual maturity ( $L_{50}$  of 130 cm) determined for females from the Gulf Atlantic halibut stock.

The commercial fishery, halibut directed or not, for the most part lands individuals measuring between 81 and 120 cm. In 2010, it was mandatory in all fisheries to return halibut measuring less than 85 cm to the water; in addition, in Newfoundland, longline cod directed fishing fleets were required to release halibut by-catches measuring 85+ cm, but the numbers released were not recorded. Thus, various studies on halibut show that the survival rate of fish caught and returned to the water is much lower in gillnet fisheries than in longline fisheries. Moreover, because it is impossible to calculate the number of halibut released back into the water, it is difficult to adequately assess the consequences on the stock, in particular the spawning fraction.

Nevertheless, given that all stock status indicators have remained comparable or higher than the series average in recent years, it is estimated that the Atlantic halibut stock in the Gulf could support a TAC increase for the next two fishing seasons (2011 and 2012) of around 20% in total. However, because of the importance of releasing Atlantic halibut back into the water in some fisheries, particularly immature individuals, management measures should be implemented to: 1) minimize Atlantic halibut by-catches as much as possible to protect the growth potential of the spawning stock; 2) record all halibut removals, including landings and releases back into the water, made by directed or non-directed fisheries. This last element is crucial for determining the extent of removals and assessing the impacts of fishing on recruit performance. Thus, a more accurate method for assessing the number of Atlantic halibut releases (numbers and weight) should be developed.

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ISSN 1919-5079 (Print)  
ISSN 1919-5087 (Online)  
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## CORRECT CITATION FOR THIS PUBLICATION:

DFO. 2011. Stock Assessment of Atlantic Halibut of the Gulf of St. Lawrence (NAFO Division 4RST) for 2009 and 2010. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/012.